

1 CLAIMS:

2 1. A laser pyrolysis particle forming method comprising:
3 feeding a first set of precursors to a first laser application zone;
4 first applying laser energy to the first set of precursors in the
5 first laser application zone effective to react and form solid particles
6 from the first set of precursors;
7 ceasing application of any effective laser energy to the solid
8 particles and feeding the solid particles and a second set of precursors
9 to a second laser application zone; and
10 second applying laser energy to the second set of precursors in
11 the second laser application zone effective to react and form solid
12 material about the solid particles from the second set of precursors.

13
14 2. The method of claim 1 wherein the first and second laser
15 application zones are different.

16
17 3. The method of claim 1 wherein the first and second laser
18 application zones are the same.

19
20 4. The method of claim 1 wherein the first and second sets
21 of precursors are the same and form substantially homogeneous solid
22 particles at the conclusion of the second applying.

1 5. The method of claim 1 wherein the first and second sets
2 of precursors are different, the second applying forming a solid material
3 coating over the solid particles which is different from material of the
4 solid particles formed in the first applying.

5
6 6. The method of claim 5 wherein said solid material is harder
7 than the material of the solid particles formed in the first applying.

8
9 7. The method of claim 5 wherein said solid material is softer
10 than the material of the solid particles formed in the first applying.

11
12 8. The method of claim 5 wherein the first and second sets
13 of precursors share at least one common precursor.

14
15 9. The method of claim 5 wherein the solid material coating
16 and the material of the solid particles formed in the first applying
17 comprise different nitrides.

18
19 10. The method of claim 5 wherein the first and second sets
20 of precursors each comprise NH_3 , and the solid material coating and
21 the material of the solid particles formed in the first applying comprise
22 different nitrides.

1 11. The method of claim 5 wherein the first and second sets
2 of precursors do not share any common precursor.
3

4 12. The method of claim 5 wherein the material of the solid
5 particles formed in the first applying comprise SiO_2 , and the solid
6 material coating comprises an elemental metal.
7

8 13. The method of claim 5 wherein the material of the solid
9 particles formed in the first applying comprise SiO_2 , and the solid
10 material coating comprises elemental tungsten.
11

12 14. The method of claim 1 comprising forming the solid
13 particles with solid material thereabout to have a maximum diameter of
14 no greater than 100 nanometers.
15

16 15. The method of claim 1 comprising forming the solid
17 particles with solid material thereabout to have a maximum diameter of
18 no greater than 1 micron.
19

20 16. The method of claim 1 further comprising forming a
21 chemical mechanical polishing slurry using the solid particles after the
22 second applying as at least a portion of a solid abrasive material within
23 the slurry.
24

17. A laser pyrolysis particle forming method comprising:
providing a reaction flow path comprising a plurality of laser application zones;
feeding a first set of precursors to a first in sequence of the laser application zones along the reaction flow path;
applying laser energy to the first set of precursors in the first in sequence of the laser application zones effective to react and form solid particles from the first set of precursors;
feeding the solid particles and a second set of precursors to a subsequent in sequence of the laser application zones along the flow path; and
applying laser energy to the subsequent in sequence of the laser application zones effective to react and form solid material about the solid particles from the second set of precursors.

18. The method of claim 17 wherein the first and second sets of precursors are the same and form substantially homogeneous solid particles at the conclusion of the second applying.

19. The method of claim 17 wherein the first and second sets of precursors are different, the second applying forming a solid material coating over the solid particles which is different from material of the solid particles formed in the first applying.

1 20. The method of claim 19 wherein said solid material is
2 harder than the material of the solid particles formed in the first
3 applying.

4
5 21. The method of claim 19 wherein said solid material is softer
6 than the material of the solid particles formed in the first applying.

7
8 22. The method of claim 19 wherein the first and second sets
9 of precursors share at least one common precursor.

10
11 23. The method of claim 19 wherein the first and second sets
12 of precursors do not share any common precursor.

13
14 24. The method of claim 17 comprising forming the solid
15 particles with solid material thereabout to have a maximum diameter of
16 no greater than 100 nanometers.

17
18 25. The method of claim 17 comprising forming the solid
19 particles with solid material thereabout to have a maximum diameter of
20 no greater than 1 micron.

1 26. The method of claim 17 further comprising forming a
2 chemical mechanical polishing slurry using the solid particles after the
3 second applying as at least a portion of a solid abrasive material within
4 the slurry.
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24

1 27. A laser pyrolysis particle forming method comprising:
2 providing a reaction flow path comprising at least first and second
3 spaced laser application zones, at least a first precursor inlet to the
4 reaction flow path in advance of the first laser application zone, and
5 at least a second precursor inlet to the reaction flow path between the
6 first and second spaced laser application zones;
7 feeding at least one precursor through the first inlet to the
8 reaction flow path in advance of the first laser application zone;
9 feeding the at least one precursor fed from the first precursor
10 inlet along the reaction flow path to the first laser application zone;
11 applying laser energy in the first laser application zone effective
12 to react and form solid particles from the at least one precursor fed
13 from the first inlet;
14 feeding the solid particles from the first laser application zone
15 along the reaction flow path to between the first and second spaced
16 laser application zones;
17 feeding at least one precursor through the second precursor inlet
18 into the reaction flow path between the first and second laser
19 application zones having the solid particles flowing therein;
20 feeding the at least one precursor fed from the second precursor
21 inlet and the solid particles along the reaction flow path to the second
22 laser application zone; and
23
24

1 applying laser energy in the second laser application zone effective
2 to react and form solid material about the solid particles from the at
3 least one precursor fed from the second inlet.

4
5 28. The method of claim 27 comprising feeding multiple
6 precursors from multiple inlets to the reaction flow path in advance of
7 the first laser application zone.

8
9 29. The method of claim 27 comprising feeding multiple
10 precursors from multiple inlets to the reaction flow path between the
11 first and second laser application zones having the solid particles flowing
12 therein.

13
14 30. The method of claim 27 comprising feeding multiple
15 precursors from multiple inlets to the reaction flow path in advance of
16 the first laser application zone, and feeding multiple precursors from
17 multiple inlets to the reaction flow path between the first and second
18 laser application zones having the solid particles flowing therein.

19
20 31. The method of claim 27 comprising feeding an inert gas to
21 the reaction flow path between the first and second laser application
22 zones having the solid particles flowing therein.

1 32. The method of claim 27 comprising flowing a mixture of
2 precursor gases through the second precursor inlet to the reaction flow
3 path between the first and second laser application zones having the
4 solid particles flowing therein.

5
6 33. The method of claim 32 comprising feeding an inert gas to
7 the reaction flow path between the first and second laser application
8 zones having the solid particles flowing therein.

9
10 34. The method of claim 27 wherein the precursors provided to
11 the first and second laser application zones are the same and form
12 substantially homogeneous solid particles at the conclusion of the laser
13 energy applying in the second zone.

14
15 35. The method of claim 27 wherein the precursors provided to
16 the first and second laser application zones are different, the laser
17 energy applying in the second zone forming a solid material coating
18 over the solid particles which is different from material of the solid
19 particles formed in the laser energy applying in the first zone.

20
21 36. The method of claim 35 wherein said solid material is
22 harder than the material of the solid particles formed in the laser
23 energy applying in the first zone.
24

1 37. The method of claim 35 wherein said solid material is softer
2 than the material of the solid particles formed in the laser energy
3 applying in the first zone.
4

5 38. The method of claim 35 wherein the precursors provided to
6 the first and second laser application zones share at least one common
- precursor.
8

9 39. The method of claim 35 wherein the precursors provided to
10 the first and second laser application zones do not share any common
11 precursor.
12

13 40. The method of claim 27 comprising forming the solid
14 particles with solid material thereabout to have a maximum diameter of
15 no greater than 100 nanometers.
16

17 41. The method of claim 27 comprising forming the solid
18 particles with solid material thereabout to have a maximum diameter of
19 no greater than 1 micron.
20

21 42. A chemical mechanical polishing slurry comprising liquid and
22 abrasive solid components, at least some of the abrasive solid
23 component comprising individually non-homogeneous abrasive particles.
24

1 43. The chemical mechanical polishing slurry of claim 42 wherein
2 the non-homogeneous abrasive particles comprise an innermost portion
3 and an outermost portion, the innermost and outermost portions
4 comprising different materials.

5
6 44. The chemical mechanical polishing slurry of claim 43 wherein
7 the material of the outermost portion is harder than the material of the
8 innermost portion.

9
10 45. The chemical mechanical polishing slurry of claim 44 wherein
11 the material of the outermost portion comprises TiN and the material
12 of the innermost portion comprises SiO₂.

13
14 46. The chemical mechanical polishing slurry of claim 44 wherein
15 the material of the outermost portion comprises WN and the material
16 of the innermost portion comprises TiN.

17
18 47. The chemical mechanical polishing slurry of claim 43 wherein
19 the material of the outermost portion is softer than the material of the
20 innermost portion.

21
22 48. The chemical mechanical polishing slurry of claim 42 wherein
23 the non-homogeneous particles are characterized by only two distinct
24 material layers.

1 49. The chemical mechanical polishing slurry of claim 48 wherein
2 one of the two layers envelopes the other.

3
4 50. The chemical mechanical polishing slurry of claim 49 wherein
5 the enveloping layer is harder than the enveloped layer.

6
7 51. The chemical mechanical polishing slurry of claim 49 wherein
8 the enveloping layer is softer than the enveloped layer.

9
10 52. A chemical mechanical polishing process comprising:
11 rotating at least one of a semiconductor substrate and polishing
12 pad relative to the other; and

13 providing a chemical mechanical polishing slurry intermediate the
14 substrate and pad, and polishing the substrate with the slurry and pad
15 during the rotating, the chemical mechanical polishing slurry comprising
16 liquid and abrasive solid components, at least some of the abrasive solid
17 component comprising individually non-homogeneous abrasive particles.

18
19 53. The process of claim 52 wherein the non-homogeneous
20 abrasive particles comprise an innermost portion and an outermost
21 portion, the innermost and outermost portions comprising different
22 materials.

1 54. The process of claim 53 wherein the material of the
2 outermost portion is harder than the material of the innermost portion.
3

4 55. The chemical mechanical polishing slurry of claim 53 wherein
5 the material of the outermost portion is softer than the material of the
6 innermost portion.
7

8 56. The chemical mechanical polishing slurry of claim 52 wherein
9 the non-homogeneous particles are characterized by only two distinct
10 material layers.
11

12 57. The chemical mechanical polishing slurry of claim 56 wherein
13 one of the two layers envelopes the other.
14

15 58. The chemical mechanical polishing slurry of claim 57 wherein
16 the enveloping layer is more dense than the enveloped layer.
17

18 59. The chemical mechanical polishing slurry of claim 57 wherein
19 the enveloping layer is less dense than the enveloped layer.
20
21
22
23
24

1 60. A particle forming method comprising:
2 feeding a first set of precursors to a first energy application zone;
3 first applying energy to the first set of precursors in the first
4 energy application zone effective to react and form solid particles from
5 the first set of precursors;
6 ceasing application of any effective energy to the solid particles
7 and feeding the solid particles and a second set of precursors to a
8 second energy application zone; and
9 second applying energy to the second set of precursors in the
10 second energy application zone effective to react and form solid material
11 about the solid particles from the second set of precursors.
12

13 61. The method of claim 60 wherein the first and second
14 applied energies are of a same type.
15

16 62. The method of claim 60 wherein the first and second
17 applied energies are different types.
18

19 63. The method of claim 60 wherein at least one of the first
20 and second applied energies comprises laser energy.
21

22 64. The method of claim 60 wherein at least one of the first
23 and second applied energies comprises a combustion flame.
24

1 65. The method of claim 60 wherein at least one of the first
2 and second applied energies comprises a plasma flame.

3
4 66. The method of claim 60 wherein at least one of the first
5 and second applied energies comprises photosynthesis.

6
7 67. A particle forming method comprising:
8 providing a reaction flow path comprising a plurality of energy
9 application zones;

10 feeding a first set of precursors to a first in sequence of the
11 energy application zones along the reaction flow path;

12 applying energy to the first set of precursors in the first in
13 sequence of the energy application zones effective to react and form
14 solid particles from the first set of precursors;

15 feeding the solid particles and a second set of precursors to a
16 subsequent in sequence of the energy application zones along the flow
17 path; and

18 applying energy to the subsequent in sequence of the energy
19 application zones effective to react and form solid material about the
20 solid particles from the second set of precursors.

21
22 68. The method of claim 67 wherein the applied energies are
23 of a same type.

1 69. The method of claim 67 wherein the applied energies are
2 different types.

3
4 70. The method of claim 67 wherein at least one of the applied
5 energies comprises laser energy.

6
7 71. The method of claim 67 wherein at least one of the applied
8 energies comprises a combustion flame.

9
10 72. The method of claim 67 wherein at least one of the applied
11 energies comprises a plasma flame.

12
13 73. The method of claim 67 wherein at least one of the applied
14 energies comprises photosynthesis.

74. A particle forming method comprising:

providing a reaction flow path comprising at least first and second spaced energy application zones, at least a first precursor inlet to the reaction flow path in advance of the first energy application zone, and at least a second precursor inlet to the reaction flow path between the first and second spaced energy application zones;

feeding at least one precursor through the first inlet to the reaction flow path in advance of the first energy application zone;

feeding the at least one precursor fed from the first precursor inlet along the reaction flow path to the first energy application zone;

applying energy in the first energy application zone effective to react and form solid particles from the at least one precursor fed from the first inlet;

feeding the solid particles from the first energy application zone along the reaction flow path to between the first and second spaced energy application zones;

feeding at least one precursor through the second precursor inlet into the reaction flow path between the first and second energy application zones having the solid particles flowing therein;

feeding the at least one precursor fed from the second precursor inlet and the solid particles along the reaction flow path to the second energy application zone; and

1 applying energy in the second energy application zone effective to
2 react and form solid material about the solid particles from the at least
3 one precursor fed from the second inlet.

4
5 75. The method of claim 74 wherein the first and second
6 applied energies are of a same type.

7
8 76. The method of claim 74 wherein the first and second
9 applied energies are different types.

10
11 77. The method of claim 74 wherein at least one of the first
12 and second applied energies comprises laser energy.

13
14 78. The method of claim 74 wherein at least one of the first
15 and second applied energies comprises a combustion flame.

16
17 79. The method of claim 74 wherein at least one of the first
18 and second applied energies comprises a plasma flame.

19
20 80. The method of claim 74 wherein at least one of the first
21 and second applied energies comprises photosynthesis.